

Claims:

1. A method for growing a thin film onto a substrate, in which method a substrate placed in a reaction space (1; 21) is subjected to alternately repeated surface reactions of at least two vapor-phase reactants for the purpose of forming a thin film, said method comprising

- feeding said reactants in the form of vapor-phase pulses repeatedly and alternately, each reactant separately from its own source, into said reaction space (1; 21), and
- bringing said vapor-phase reactants to react with the surface of the substrate for the purpose of forming a solid-state thin film compound on said substrate,

characterized in that

- the gas volume of said reaction space is evacuated essentially totally between two successive vapor-phase reactant pulses.

2. A method as defined in claim 1, characterized in that said gas volume of said reaction space (1; 21) is evacuated at least twice, advantageously at least 3 - 10 times during the interval between said vapor-phase reactant pulses.

3. A method as defined in claim 1 or 2, characterized in that said gas volume of said reaction space (1; 21) is evacuated so that the residual components of the preceding vapor-phase reactant pulse remaining in the reaction space are at a level of less than 1 %, advantageously less than 1 ‰, prior to the inflow of the successive vapor-phase pulse.

4. A method as defined in any of foregoing claims 1 - 3, characterized in that an inactive gas is fed into said reaction space (1; 21) simultaneously as the reaction space is being evacuated from the residues of the latest vapor-phase reactant pulse.

5. A method as defined in claim 4, characterized in that said reaction space is connected a pump (3; 24) having a volumetric capacity which during the interval between two successive vapor-phase reactant pulses is appreciably greater than the gas volume of the reaction space.

6. A method as defined in any foregoing claim, characterized in that each reactant is fed into said reaction space via a separate inflow path (22, 29; 23, 28) in order to minimize the gas volume to be evacuated from the reaction space.

7. A method as defined in any foregoing claim, characterized in that each vapor-phase reactant pulse is mixed with said inactive gas flow prior to its entry into said reaction space.

8. A method as defined in claim 1, in which method a reaction space is employed comprising a reaction chamber (13; 38) into which said substrate can be placed and further comprising gas flow channels (7, 8, 14 and 4; 22, 23, 28, 29, 25 and 24) communicating with said reaction chamber, said gas flow channels being suited for the inflow of said vapor-phase reactant pulses into said reaction chamber and, correspondingly, for the outflow of the nonreacted components of said reactant pulses from said reaction chamber, characterized in that at least a portion of said gas flow channels are provided with a narrow, oblong cross section in order to minimize the volume of said reaction space.

9. A method as defined in claim 1 or 8, in which method a reaction space is employed comprising a reaction chamber (13; 38) into which said substrate can be placed and further comprising gas flow channels (7, 8, 14 and 4; 22, 23, 28, 29, 25 and 24) communicating with said reaction chamber, said gas flow channels being suited for the inflow of said vapor-phase reactant pulses into said reaction chamber and, correspondingly, for the outflow of the nonreacted components of said reactant pulses from said reaction chamber, characterized in that

said reaction chamber (13; 38) is provided with a narrow, oblong cross section in order to minimize the volume of said reaction space.

10. A method as defined in claim 9, characterized in that said vapor-phase reactant pulses are fed via gas flow channels (7, 8, 14 and 4; 22, 23, 28, 29; 25 and 24) having a narrow, oblong cross section in order to form at least essentially planar pulses of vapor-phase reactant and to improve the intermixing of the vapor-phase reactant flow with a carrier gas flow.

11. A method as defined in claim 9, characterized in that said vapor-phase pulses of each reactant group are fed via their individual inflow channels (22, 29; 23, 28) directly into the reaction chamber, wherein the vapor-phase pulse is allowed to intermix with a carrier gas flow prior to bringing the reactant into contact with the substrate.

12. A method as defined in claim 1, characterized in that said vapor-phase reactant pulses are fed in an at least essentially laminar flow into said reaction chamber.

13. An apparatus for growing thin films onto a substrate by subjecting the substrate to alternately repeated surface reactions of vapor-phase reactants for the purpose of forming a solid-state thin film on the substrate, said apparatus comprising

- a reaction space (13; 38) into which the substrate can be placed,
- inflow channels (7; 22, 29, 23, 38) communicating with said reaction space, said channels being suited for feeding the reactants employed in a thin-film growth process in the form of vapor-phase pulses into said reaction space, and
- reactant outflow channels (4; 25) communicating with said reaction space, said channels being suited for the outflow of reaction products and excess amounts of reactants from said reaction space,

characterized in that

- the outflow channels (4; 25) are provided with a connection (3; 24) to a pump capable of evacuating said reaction space to a vacuum and said pump having a volumetric capacity which during the interval between two successive vapor-phase reactant pulses is greater than the gas volume of the reaction space.

14. An apparatus as defined in claim 13, characterized in that said pump has a volumetric capacity which during the interval between two successive vapor-phase reactant pulses is capable of evacuating at least twice the gas volume of the reaction space.

15. An apparatus as defined in claim 13 or 14, said apparatus comprising a reaction chamber (13; 38) into which the substrate can be placed and further comprising gas flow channels (7, 8, 14 and 4; 22, 23, 28, 29, 25 and 24) communicating with said reaction chamber, said gas flow channels being suited for the inflow of said vapor-phase reactant pulses into said reaction chamber and, correspondingly, for the outflow of the reaction products of said thin-film growth process and the excess amounts of said reactant pulses from said reaction chamber, characterized in that at least a portion of said gas flow channels are provided with a narrow, oblong cross section in order to minimize the volume of said reaction space.

16. An apparatus as defined in claim 15, characterized in that said reaction chamber (13; 38) is provided with a narrow, oblong cross section in order to minimize the volume of said reaction space.